Research Note

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HOW FAST IS TIMBER GROWING IN EASTERN MONTANA?[1/]

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Montana, east of the Continental Divide, is an area of comparatively slow timber growth. The forest soil in most areas is thin and rocky, the growing season is short, and except at high altitudes the precipitation is low. An inventory of the timber resource of this area from 1946 to 1949 obtained growth data which show what timber growth has averaged for the past 10 years. Despite the above factors eastern Montana as a timber producing area shows a growth rate better than previously supposed.

To answer the question, "How fast is timber growing in eastern Montana?" two calculations have been made (1) board-foot and cubic-foot growth per unit of saw-timber and primary growing stock respectively[2/] and (2) the growth percent for major species. Growth, as used in this Note, applies to natural, unmanaged stands which have had some protection and very little cutting in recent years. Growth percent was derived for individual species for two stand-size classes and for three diameter groups of the growing stock. Variations not taken into account in analysis of the growth data were the composition of mixed stands, site quality, and density of stocking. Growth was related to diameter rather than to age, with diameter being used as a rough guide to age. Generally speaking the relation between diameter and age is as follows: pole trees (5.0" to 10.9" d.b.h.) 60 to 120 years, small saw-timber trees (11.0" to 20.9" d.b.h.) 121 to 180 years, and medium saw-timber trees (21.0" to 30.9" d.b.h.) 181 to 280 years.

1/ See note on page 7 for brief description of source of data.

2/ Saw-timber growing stock is the volume of live, sound trees 11.0" minimum d.b.h. from a 1.0-foot stump to a 6.0" top. Primary growing stock is the volume of live, sound trees 5.0" minimum d.b.h. from a 1.0-foot stump to a 4.0" top.

In analyzing growth the following components were recognized: main growth, the increment on trees that remained in the stand-size class during a 10-year period; ingrowth, the volume of trees that changed from one size class to the next higher one during the 10-year period, i.e. outgrew a size class during the decade; mortality, the volume of trees which died during the period; and net growth, the main growth plus ingrowth minus mortality.[3/] These growth components for saw-timber trees and for primary growing stock are shown in tables 1 and 2 by stand-size class.

Table 1. Growth of saw-timber growing stock by stand-size class - all species

Stand-size class	Volume of average stand	Main growth	In-growth	Mor-tality	Net growth
	Board feet per acre[1/]				
Saw-timber	6690	80	33	25	88
Pole	1075	15	14	7	22
Seedling-sapling and deforested	215	4	2	2	4
All stands	2150	27	16	10	33

1/ Scribner log rule.

Table 2. Growth of primary growing stock by stand-size class - all species

Stand-size class	Volume of average stand	Main growth	In-growth	Mor-tality	Net growth
	Cubic feet per acre				
Saw-timber	2090	25	11	7	29
Pole	1090	20	9	3	26
Seedling-sapling and deforested	160	2	5	1	6
All stands	1120	17	9	4	22

3/ A detailed description of the method of growth determination is given in Montana Forest Resource and Industry Statistics, Northern Rocky Mountain Forest and Range Experiment Station paper 25, page 36, October 1950.

The periodic annual growth percent for five species in eastern Montana during the period 1938 to 1948 is shown in table 3.

Table 3. Periodic annual growth percent[1/] for cubic feet of pole timber and board feet of saw timber

Stand-size class and diameter group	Species				
	Ponderosa pine	Douglas-fir	Engelmann spruce	Lodgepole pine	Cotton-wood
	Percent				
Pole-timber stands 2/					
Pole trees	3.8	3.0	2.9	2.5	--
Small saw-timber	3.1	2.0	3.7	1.6	--
Medium saw-timber	--	1.4	--	--	--
Saw-timber stands 2/					
Pole trees	2.4	2.6	2.3	1.6	--
Small saw-timber	2.0	1.6	1.7	1.1	3.5
Medium saw-timber	0.6	1.1	1.0	--	2.3

1/ Growth percent was derived by using the formula for simple interest and is based only on main growth.

2/ Pole-timber stands are mostly stocked with pole-timber trees and do not meet the minimum specification for a saw-timber stand. Saw-timber stands are defined as having a minimum net volume per acre of 2500 board feet, Scribner log rule.

Species growth is expressed in standard units of growing stock in tables 4 and 5. The growth of individual species shown in these tables is a component of the total growth for all species in saw-timber and pole-timber stands as set forth in tables 1 and 2. In general the ponderosa and lodgepole pine growth data in tables 4 and 5 are for nearly pure stands, whereas the Douglas-fir data are for mixed stands. The data for average volume per acre of growing stock are a guide to stocking and when multiplied by net growth per unit of growing stock are an indication of the average net growth per acre for a given species.

Table 4. Growth per thousand board feet of saw-timber growing stock by species

Diameter group and species	Average volume per acre of growing stock	Main growth	Ingrowth	Mortality	Net growth
		Board feet			
SAW-TIMBER STANDS					
Small saw-timber (11.0" to 20.9" d.b.h.)					
Ponderosa pine	1667	13	5	1	17
Douglas-fir	2842	11	4	3	12
Lodgepole pine	4700	7	7	4	10
Medium saw-timber (21.0" to 30.9" d.b.h.)					
Ponderosa pine	545	5	2/	1/	5
Douglas-fir	1044	8	2/	4	4
Lodgepole pine	140	2	2/	1/	2
POLE-TIMBER STANDS					
Small saw-timber (11.0" to 20.9" d.b.h.)					
Ponderosa pine	491	18	7	7	18
Douglas-fir	1640	12	13	2	23
Lodgepole pine	739	9	15	9	15
Medium saw-timber (21.0" to 30.9" d.b.h.)					
Ponderosa pine	49	2	2/	14	-12
Douglas-fir	500	10	2/	1/	10

1/ Less than one board foot.

2/ According to the sample no trees moved into this diameter group.

Table 5. Growth per hundred cubic feet of primary growing stock by species

Diameter group and species	Average volume per acre of growing stock	Main growth	In-growth	Mortality	Net growth
		Cubic feet			
SAW-TIMBER STANDS					
Pole timber (5.0" to 10.9" d.b.h.)					
Ponderosa pine	118	2.0	1/	0.2	1.8
Douglas-fir	255	2.0	0.2	0.1	2.1
Lodgepole pine	680	1.4	0.1	0.2	1.3
Small saw-timber (11.0" to 20.9" d.b.h.)					
Ponderosa pine	511	1.2	0.8	0.2	1.8
Douglas-fir	663	1.0	0.6	0.4	1.2
Lodgepole pine	1027	0.7	0.9	0.5	1.1
Medium saw-timber (21.0" to 30.9" d.b.h.)					
Ponderosa pine	143	0.5	2/	1/	0.5
Douglas-fir	212	0.9	2/	0.5	0.4
Lodgepole pine	28	1/	2/	1/	1/
POLE-TIMBER STANDS					
Pole timber (5.0" to 10.9" d.b.h.)					
Ponderosa pine	246	2.6	0.6	0.1	3.1
Douglas-fir	858	2.1	0.8	0.1	2.8
Lodgepole pine	1228	1.9	0.9	0.2	2.3
Small saw-timber (11.0" to 20.9" d.b.h.)					
Ponderosa pine	140	1.7	1.0	0.8	1.9
Douglas-fir	436	1.0	1.7	0.1	2.6
Lodgepole pine	164	0.8	1.9	1.2	1.5
Medium saw-timber (21.0" to 30.9" d.b.h.)					
Ponderosa pine	11	0.4	2/	1.5	-1.1
Douglas-fir	105	1.0	2/	1/	1.0

1/ Less than 0.1 cubic foot.

2/ According to the sample no trees moved into this diameter group.

INTERPRETATION OF DATA

As was pointed out at the beginning of this paper, the growth data presented are for unmanaged stands which have had some protection and scattered cutting. Under these conditions the annual net growth on trees 5.0" and larger in saw-timber stands was found to be 29 cubic feet per acre per year, and on saw-timber trees 11.0" and larger in saw-timber stands 88 board feet per acre per year. For the total area of commercial forest land in eastern Montana the annual net growth amounted to 260 million board feet for the period 1938 to 1948. Experience has indicated that when intensive management practices are applied higher growth rates than given here can be expected.

In applying 1938-1948 growth rates to smaller units in eastern Montana variations from the average must be taken into account. Knowledge of local conditions and use of sound judgment are essential. Three factors particularly should be watched: stocking, site, and climatic trends.

Previous growth studies have pointed to the fact that growth per acre varies by density of stocking. Since in this analysis growth was not calculated by stocking groups, limits in stocking and observations of conditions may be of some help in interpreting and applying the growth data. In the study the minimum growing stock for classifying saw-timber stands was 2500 board feet per acre and few of the saw-timber stands exceeded 12,500 board feet. The average stocking was 6690 board feet. (Table 1.) But observations of field men and a review of the data concur that stocking for most of the area is slightly lower than the average, possibly close to 6000 board feet. Where stocking is less than this in local units the growth rate per unit of growing stock is probably slightly greater than indicated in this study. Likewise, where stocking is heavier, the growth rate may be less.

Site quality when measured by regional standards tends to be poor in eastern Montana. Thus, in local areas where site may be classed as medium or good, higher growth rates should be used, and on extremely poor sites the rate should be reduced.

Because precipitation and temperature relations vary widely from year to year in eastern Montana, climate is another factor to consider in the use of growth data. A particularly prolonged and severe drouth period of the 1930's was followed by a period of above-average rainfall in 1938 to 1948. Future precipitation trends will have an affect on growth. Likewise, the timber stand location should be taken into account in estimating the influence of climate on growth. Ponderosa

pine stands of eastern Montana border the plains area. Growth in these stands was measured during a period of above-average rainfall. If a period of drouth occurs, the annual growth rate for ponderosa pine growing stock should be revised downward and the mortality increased.

Lodgepole pine, Douglas-fir, and spruce stands generally occur above the ponderosa pine type. Moisture is usually adequate in the mountains and relatively dry years have temperatures more favorable for rapid growth. In such periods, growth rates of these species should be revised slightly upward.

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1/ The data in this Note were obtained by the Forest Survey project. While making an inventory and growth survey of the timber resource, growth records were obtained for more than 2500 trees selected at random throughout eastern Montana. Tabulations of the data for the Forest Survey project were such as to give total growth and were not designed to analyze the various factors relating to growth.

Since growth studies have not been made and are not in prospect for this area, it was felt that it might be helpful to foresters to have a brief summary and interpretation of the Forest Survey growth data. Limitations in time and funds did not permit detailed analysis of the Survey growth data.